AED

Academy for Educational Development

ARMENIA ENERGY TRAINING PROGRAM

Contract No. LAG-I-00-98-00011-00, Task Order Two

Technical Report

Course on *Wholesale and Retail Tariff Structure*

April 16, 1999

Submitted to U.S. Agency for International Development

Submitted by the Academy for Educational Development
with Hagler Bailly Services

ARMENIA ENERGY SECTOR TRAINING PROGRAM
Technical Report
Course # 2 : Wholesale and Retail Tariff Structures for Electricity

USAID Strategic Objective 1.5	A more economically sustainable and environmentally sound energy sector
Intermediate Result 2	Increased economic efficiency in the energy sector
Participant profile	Armenia's energy companies, government ministries and regulatory entities with competence over the energy sector

A. Course Purpose

Armenia currently is moving towards introduction of a time-differentiated tariff structure in electric power sector. The tariff is anticipated to cut peak power demand and result in substantial savings to the power sector and to the economy as a whole. The goal of this training program was to introduce the basic concepts associated with wholesale and retail tariff structures, and to provide attendees with sufficient skills to begin to design appropriate tariffs within Armenia.

B. Dates/Trainers/Attendees

The course was conducted February 15-19, 1999. Leszak Kasprowicz served as the primary instructor. Boris Shapiro, Jake Delphia, and Bruce Hutchinson also taught sections of the course. All of the trainers received positive evaluations from course participants on the course evaluation form. The list of participants is shown as Table 1. Participants represented a variety of Armenian energy sector organizations, including energy producers, distributors, and the Energy Regulatory Commission. The consumer perspective was represented by representatives from the Consumers' Union of Armenia.

TABLE 1: LIST OF PARTICIPANTS

#	Name	Employer	Feb.15	Feb.16	Feb.17	Feb.18	Feb.19
1	Marine Petrosyan	Ministry of Energy	•	•	•	•	•
2	Gagik Tokmajan	Ministry of Finance	•	•	•	•	•
3	Garegin Baghramyan	ERC	•	•	•	•	•
4	Anahit Avetisyan	ERC		•	•	•	•
5	Anahit Babayan	ERC		•	•	•	•
6	Arthur Vardanyan	ERC		•	•	•	•
7	Aram Karapetyan	ERC			•	•	•
8	Zoya Galstyan	Armenergo	•	•	•	•	•
9	Tigran Vardanyan	Armenergo	•	•	•	•	•
10	Samvel Galstyan	Southern Network	•				
11	Marine Hovhannisyan	Southern Network	•	•		•	
12	Araik Zakaryan	Southern Network	•			•	
13	Vanush Fakhuryan	Southern Network		•			
14	Anahit Sarksyan	Yerevan TPP		•	•	•	•
15	Ruben Aleksanyan	Sevan-Hrazdan Cascade		•	•	•	•
16	Vahe Petrosyan	Vorotan Cascade	•	•	•	•	•
17	Aleksander Galoyan	ANPP		•	•	•	•
18	Grigor Manoukyan	ANPP		•	•	•	•
19	Armen Poghosyan	Consumers' Association	•	•	•	•	•
20	Gagik Mkrtchyan	Consumers' Association	•				
21	Armen Galstyan	Consumers' Association	•	•	•	•	•
22	Rafik Sarkisyan	Consumers' Association					
23	Svetlana Ganjumyan	Institute of Energy		•	•	•	•

C. Material Covered

The course focus fell into five key areas: Wholesale Tariffs, Distribution Tariffs, Cost of Service, Retail Tariffs, and Regulatory Considerations. The agenda is attached as Appendix A. The course materials presented are attached as Appendix B.

From the instructors' perspective, the seminar seemed to be a strong tool for helping to introduce issues and concepts that are an important part of the overall restructuring program. The course included a lot of active discussion that allowed for increased interaction both between instructors and participants, and among the participants themselves.

D. Participant Evaluations

AED administered an exit questionnaire to assess participant satisfaction with the course immediately after its conclusion. The following key points emerged from the evaluation.

- Most of the participants believe that the course will be very useful for them, is directly relevant to their work, and that it was conducted at the appropriate level. Participants indicated that they anticipate applying what they learned in the course to their work.

- Participants gave the instructors high marks for the course. Most participants indicated that they have made arrangements to maintain contact with the instructors and/or each other through e-mail, telephone, etc.

- The instructors' knowledge of Russian made their interaction with the audience very close and comprehensive. Several participants requested that translation of the course materials be done by individuals with a greater knowledge of the sector, since some of the more technical information was not translated precisely.

- Participants expressed interest in the eight remaining courses to be conducted under this training program, and indicated that they would like to receive information about the other sessions so that they can plan to attend, if possible.

- Participants considered the program to be well-designed and well-organized, and to have met its objectives.

- Participants offered several suggestions for future courses. They would like to see more examples and practical exercises that require them to apply what they are learning. Most participants also indicated that they felt this training program was too short for the amount of material covered, and that they would like to see longer programs in this area in the future.

E. Anticipated Outcomes

Short-Term: Participants will maintain contact with the instructors and with each other as the reform process moves forward.

Hagler Bailly will continue to work with the key players to finalize two-part tariffs for generation, the bulk supply tariff, and transmission and distribution wheeling tariffs. Dialogue will continue among the participants and workshop instructors as the process moves forward.

Long-Term: In the longer term, participants are expected to be prepared for initial implementation of the to-be-proposed tariff structure.

F. Recommended Follow-up

Contact should be maintained with course attendees as the tariff reforms move forward. A number of attendees indicated that they considered the workshop to have been too short for the material covered, and USAID may want to consider conducted a second seminar on this topic when the tariff structure is adopted to deal with issues associated with its implementation.

G. Conclusions

Overall, the workshop was positively received and was given high marks by the attendees. This seminar seems to have helped advance the reforms being undertaken under the Armenia Power Sector Reform project by increasing knowledge about how the different types of tariffs work generally and how they may work in Armenia, specifically, shortly before such tariffs are introduced in Armenia.

One key area to which more attention needs to be paid for future courses is the translation of the course materials, since it is important that the participants receive the correct message from the lecturers since very often a proper word choice plays a critical role.

APPENDIX A

Seminar Outline

Wholesale And Retail Electricity Tariff Structuring

Seminar Outline

Armenian Power Sector

Wholesale And Retail Electricity Tariff Structuring

Course Instructor: Leszak Kasprowicz, Hagler Bailly

Day 1

Topic One: Wholesale Tariffs

I. Power Market Reform

- A. Participants
- B. Service Providers
- C. Energy Commission Role
- D. The use of tariffs in the restructured Power Market

II. Designing Rates

- A. Understandability
- B. Proper incentives to providers and recipients of service
- C. Proper risk allocation
- D. Opportunity to fully recover revenue requirement

III. Tariff Methodology

- A. Generation tariffs
  - 1. Local Generator Tariffs
  - 2 Import Tariffs
  - 3. Ancillary Services Tariffs
- B. Transmission Tariffs
  - 1. Connection charges

2. System Upgrade

3. Wheeling

4. Losses

Day 2

Topic One Con't: Wholesale Tariffs

III. Tariff Methodology (Continued)

A. Dispatch Tariffs

B. Wholesale Contracting Tariffs

C. Funds Administration Tariffs

D. Bulk Supply Tariffs

Topic Two: Distribution Tariffs

I. Application and Examples of Wholesale Tariffs

A. Distribution Wheeling Tariffs

B. Customer Eligibility

C. Wheeling Rates

D. Connection Charge

E. Metering Requirements

F. Reactive Power Provisions

G. Energy Balancing

H. Impact on Other Customers

I. Contractual Terms and Conditions

J. System Upgrades

II. Methodology and Examples

A. Micronets

B. Performance-Based Regulation

Day 3

Topic Three: Cost of Service

I. Definitions

A. Embedded Cost

B. Marginal Cost

II. Functionalization of Costs

A. Generation

B. Transmission

C. Distribution

D. General

III. Classification of Costs

A. Demand

B. Energy

C. Customer

IV. Allocation of Costs

A. Customer Classes

B. Voltage level

V. Revenue Requirements

A. Fixed Costs

B. Variable Costs

VI. Methodology and Examples

Day 4

Topic Four: Retail Tariffs

I. Customer Data

A. Load Data

B. Sales Data

II. Rate Components

A. Customer Charge

B. Energy Charge

C. Demand Charge

III. Rate Design

A. Energy-only Rates

B. Energy and Demand Rates

IV. Special Rates and Concepts

A Lifeline Rates

B. Demand Ratchet

C. Time-of-use Rates

D. Interruptible Rates

E. Standby Rates

F. Economic Development Rates

V. Methodology and Examples

Day 5

Topic Four Con't: Retail Tariffs

I. Influencing Customer Behavior

A. Demand-side Management (DSM) Concept

1. Passive DSM

2. Active DSM

B. DSM Programs

1. Design

2. Implementation

3. Evaluation

II. Methodology and Examples

Topic Five: Regulatory Considerations

I. Tariff Change Process

A. Utility-initiated Filing

1. Commission-initiated Review

2. Tariff Review and Approval Process at the Commission

3. Enforcement

II. Customer-Electric Utility Issues

A. Rights and Obligations

1. Quality of electric Service

a) Payment for Electric Services

b) Termination of Electric Service

2. Disputes and Their Resolution

III. Questions and Answers-Discussion

A. Conclusion of the Course

APPENDIX B

Seminar Materials

Wholesale And Retail Electricity Tariff Structuring

Cost of Service

Presented by

Bruce N. Hutchinson

Hagler Bailly Services, Inc.

Yerevan, Republic of Armenia

February 1999

Cost of Service

Discussion Outline

- Definitions
- Functionalization of costs
- Classification of Costs
- Allocation
- Revenue Requirements
- Rate Design

Cost of Service

Definition

Cost of Service is the expert estimation of the costs of providing electric service to customers.

Cost of Service

Definitions

- Embedded Costs - the historical costs which have been expended by the utility

- Marginal Costs- the costs of providing an additional unit of capacity, or energy, or both to meet the additional capacity or energy requirements of customers

Uses for Cost of Service

- Rate Design
- Support for price levels for various classes
- Cost trends (year by year)
- Earnings (by customer group)
- Sales promotion (to show relative profitability by class of service)

Types of Cost of Service

- Specific areas of service territory
- Urban and Rural
- Voltage Classes
- Customer classes
- Rate Classes
- Load types (specific industry or customer)
- Appliances and equipment

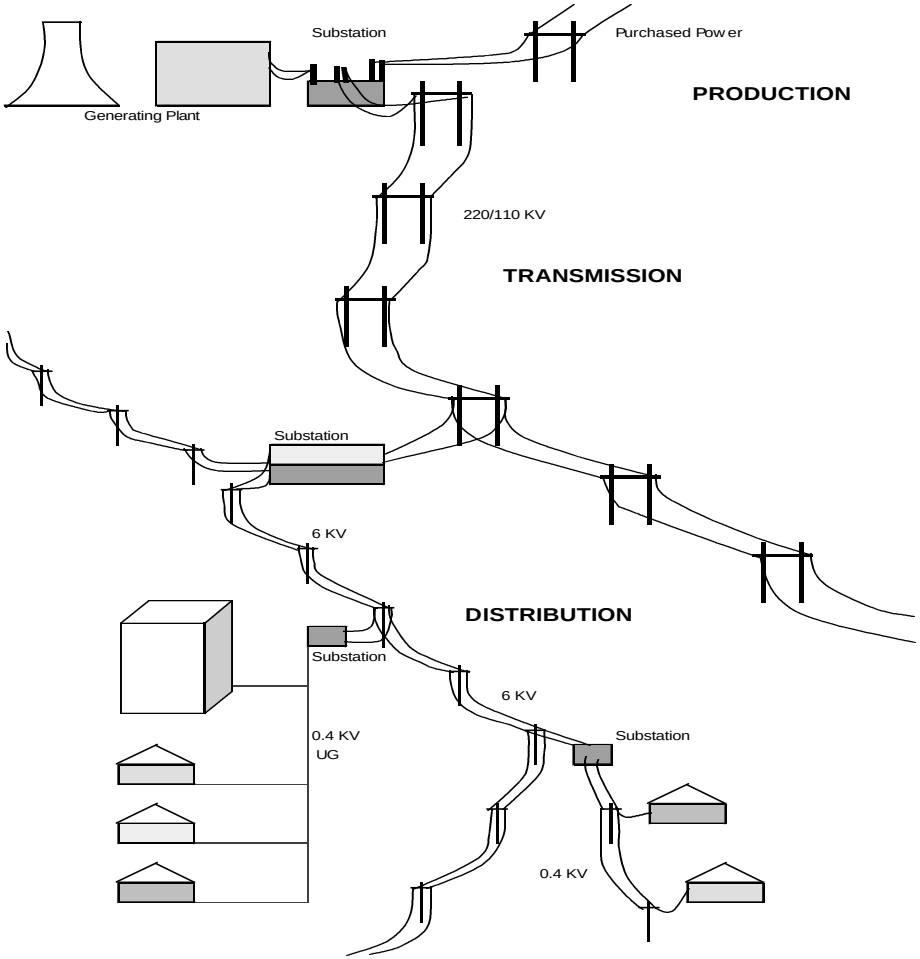
Cost of Service

Functionalization of Costs

- Generation
- Transmission
- Distribution
- General

Cost of Service

Functionalization of Costs



Cost of Service

Classification of Costs

- Demand - Kilowatts
- Energy - Kilowatt-hours
- Customer - Number of customers

Cost of Service

Allocation of Costs

- Customer Classifications
  - Residential
  - Commercial
  - Industrial
  - Other
- Voltage Level Delivery
  - High voltage
  - Medium voltage
  - Low Voltage

Cost of Service

Allocation of Costs (Losses)

- Classification of Losses
  - Demand (KW)
  - Energy (KWH)
- Levels of Losses
  - Generation
  - Transmission
  - High voltage distribution
  - Distribution

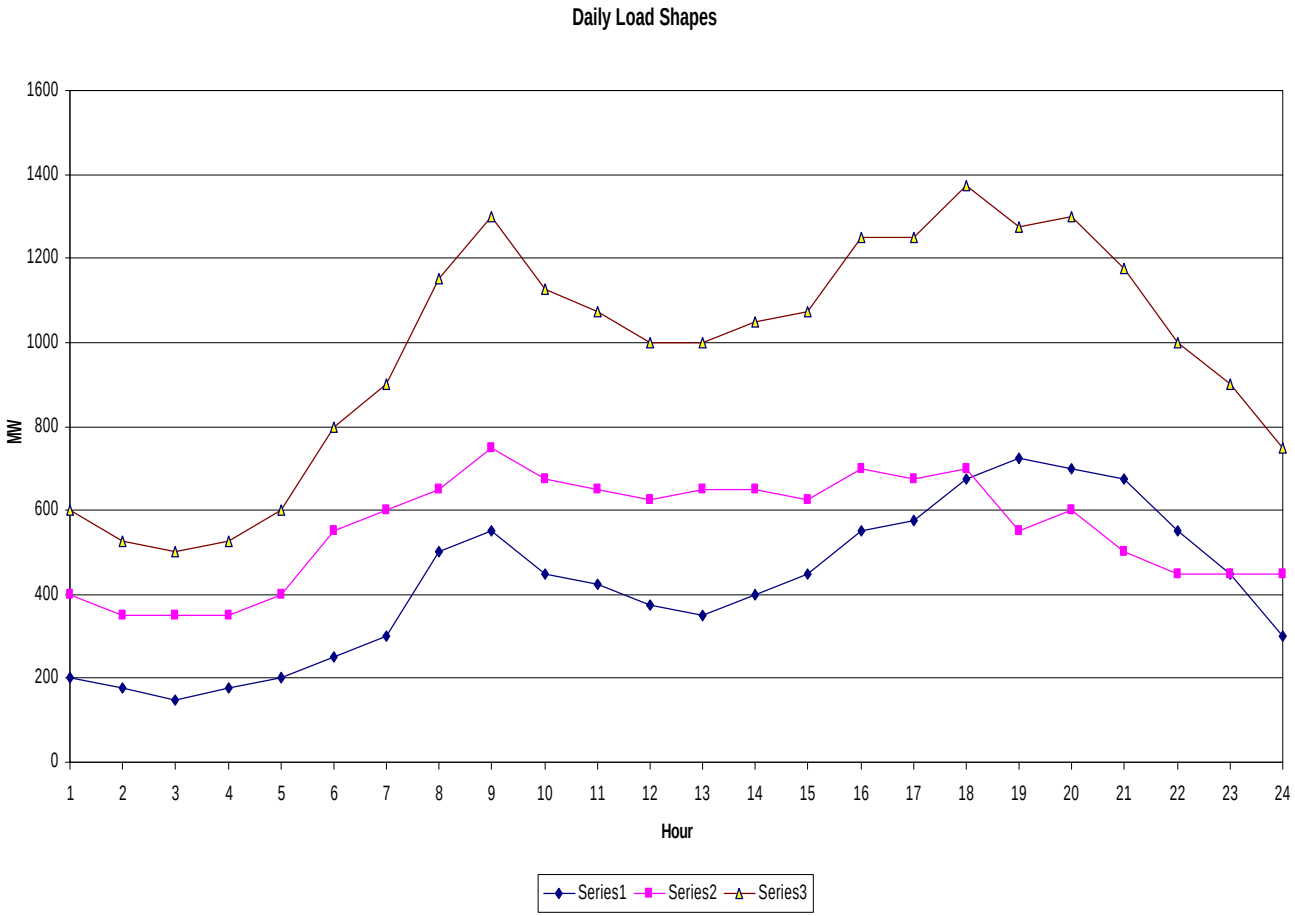
Cost of Service

Allocation Methodologies

- System Peak Loads
  - Single Peak
  - Average of Monthly Peaks
  - Summer/Winter Peak
- Energy Usage
- Combination of Peak loads and energy usage
- Customers
  - Number of Customers
  - Weighted Customers

Cost of Service

Allocation Methodologies



Cost of Service

Revenue Requirements

- **Fixed Costs -** Costs which are incurred regardless of the level of usage by the customers. These costs include: depreciation, certain taxes, some wages,

- **Variable Costs** - Costs which vary directly in proportion to the sales of energy. These costs include: fuel, operation and maintenance,

Cost of Service

Rate Design

The cost of service study should be used as a help to the design of rates. It is not the only tool for designing rates, but provides information based on technical and economic principles.

Definitions

- **Price discrimination-**charging two or more different prices for the same product or service when the cost of supplying comparable units of output does not vary
- **Cross subsidization-**charging a class of customers a price that is greater or less than an acceptable cost standard for serving that class
- **Predatory pricing-**setting prices designed to destroy a competitor
- **Limit-entry pricing-**setting a price designed to foreclose entry into a market by a potential competitor

What is a Tariff?

- **Rate-**the price for electric service
- **Schedule-**provisions necessary for billing for various load conditions of the customers
- **Rules and regulations-**a statement of the general practices the utility follows in carrying on its business with its customers
- **Tariff-**all rates, schedules and rules and regulations in a single document

Purpose of the Tariffs

- to reflect the cost of serving different customer classes
- to provide incentive to reduce/increase demand
- to retain customers on the system
- to respond to particular customer needs
- to spur economic development
- to provide competitive advantage for customers and utilities
- to offer choices to a customer

Customers

- The main reason why we have electric systems in place
- The main cause of costs associated with the operation of the electric systems

This is why the electric companies should know their customers, especially:

- number of customers they serve
- types of customers, their income level and demographics
- their profile of energy use and typical end-uses
- customer needs regarding the electric service

Data Acquisition

- Steps involved in load and other customer data acquisition
  - Design of Study
  - Collection of Data
  - Estimation of historic loads and information by class
  - Use of data

Selecting Customers

- Defining an Objective
  - Why will the information be collected?
  - Which customer group(s) will be targeted?
  - How will the information be used?
- Selecting Customers
  - Large loads-collect information on every customer
  - Small customers-collect information for a selected sample group for each customer class to be studied
  - Selection criteria and size of the sample should be statistically unbiased and valid

Data Collection

- Installation of load recorders
- Customer billing information
- Duration of study-preferably 12 consecutive months
- Demographic information collection
- Appliance (end-use) saturation data
- Use of surveys
- Use of focus groups

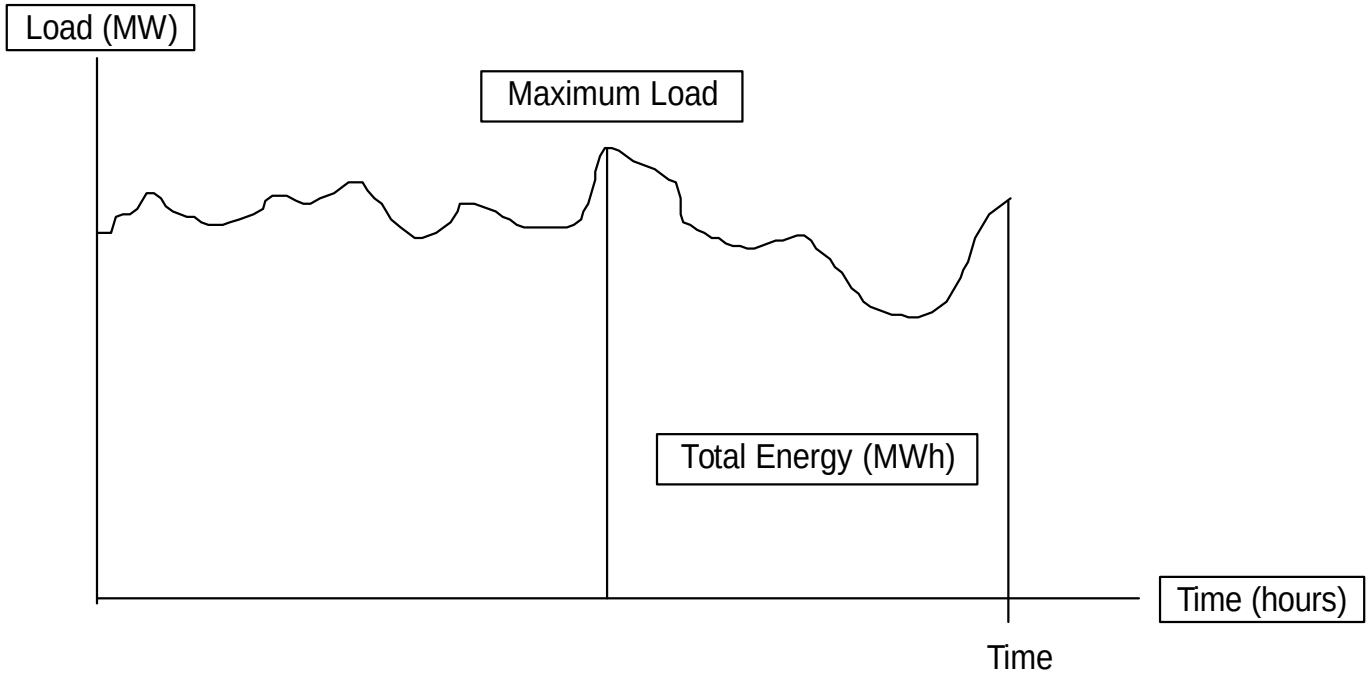
Load Data Use

- designing rates
- evaluating conservation measures
- forecasting system peaks and load profile
- predicting customer behavior
- marketing research studies
- monitoring

Examples of Compiled Data

- **Coincident Demand-**demand of a rate class at the time of a specified system peak hour
- **Non-coincident Demand-**maximum demand of a rate class, regardless of when it occurs
- **Coincident Factor-**ratio of the coincident demand of a class to its non-coincident demand
- **On-peak and off-peak kilowatt-hours**
- **Load Factor-**the ratio of average demand over a designated time period to the maximum demand occurring in that period

Load Factor



$$LF = \frac{\text{Total Energy}}{\text{Time} * \text{Maximum Load}} * 100\ \%$$

Monthly Residential Billing Data-Example

		Bills Ending in Block				Total kWh for Bills Ending in Block				Total kWh Billed in Block			
	Block Size	Number		Percentage		Number		Percentage		Number		Percentage	
kWh Block	kWh	Each Block	Cumm.	Each Block	Cumm.	Each Block	Cumm.	Each Block	Cumm.	Each Block	Cumm.	Each Block	Cumm.
0-10	10	15	15	1.5	1.5	75	75	0.1	0.1	9,925	9,925	9.9	9.9
11-20	10	27	42	2.7	4.2	405	480	0.4	0.5	9,715	19,640	9.7	19.6
21-25	5	18	60	1.8	6.0	405	885	0.4	0.9	4,745	24,385	4.7	24.4
26-50	25	118	178	11.8	17.8	4,425	5,310	4.4	5.3	22,025	46,410	22.0	46.4
51-75	25	180	358	18.0	35.8	11,250	16,560	11.3	16.6	18,300	64,710	18.3	64.7
76-100	25	213	571	21.3	57.1	18,638	35,198	18.6	35.2	13,388	78,098	13.4	78.1
101-125	25	179	750	17.9	75.0	20,138	55,336	20.1	55.3	8,488	86,586	8.5	86.6
126-150	25	98	848	9.8	84.8	13,475	68,811	13.5	68.8	5,025	91,611	5.0	91.6
151-175	25	58	906	5.8	90.6	9,425	78,236	9.4	78.2	3,075	94,686	3.1	94.7
176-200	25	36	942	3.6	94.2	6,750	84,986	6.8	85.0	1,900	96,586	1.9	96.6
201-225	25	21	963	2.1	96.3	4,463	89,449	4.5	89.4	1,188	97,774	1.2	97.8
226-250	25	14	977	1.4	97.7	3,325	92,774	3.3	92.8	750	98,524	0.8	98.5
251-275	25	10	987	1.0	98.7	2,625	95,399	2.6	95.4	450	98,974	0.5	99.0
276-300	25	6	993	0.6	99.3	1,725	97,124	1.7	97.1	250	99,224	0.3	99.2
over 300		7	1,000	0.7	100.0	2,876	100,000	2.9	100.0	776	100,000	0.8	100.0
Total		1,000		100.0		100,000		100.0		100,000		100.0	

Rate Components

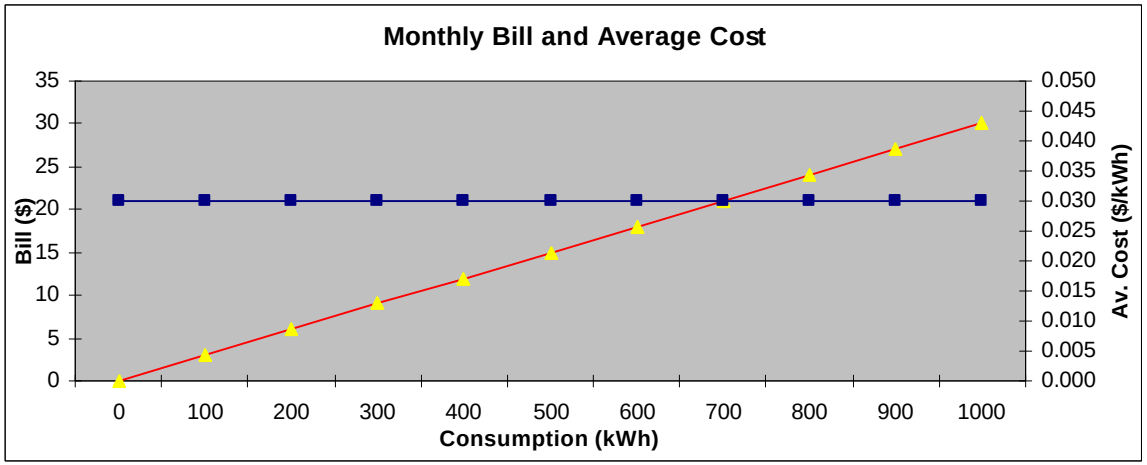
- **Customers Charge-**reflects investment charges and expenses related to a portion of the general distribution system, connection facilities, metering equipment, meter reading, billing and accounting. Expressed in $/customer
- **Energy Charge-**reflects costs of energy supplied to customers. Expressed in $/kWh
- **Demand Charge-**reflects costs of servicing the customer's demand. Includes investment charges and expenses in connection with generating plants, transmission lines, substations, and part of distribution system not included in customer charge. Expressed in $/kW
- **Adjustments-**surcharges and refunds. Expressed in $/kWh

Optimal Rates

- are cost-of-service based to ensure equity and avoid discrimination
- provide stable and predictable revenues
- provide consistent price signals
- are simple
- encourage efficient operations and efficient use of resources
- support quality service
- are competitive

Flat Rate

Energy	Rate	Total Bill	Av. Cost
0	$ 0.030	$ -	
100	$ 0.030	$ 3.00	$ 0.030
200	$ 0.030	$ 6.00	$ 0.030
300	$ 0.030	$ 9.00	$ 0.030
400	$ 0.030	$ 12.00	$ 0.030
500	$ 0.030	$ 15.00	$ 0.030
600	$ 0.030	$ 18.00	$ 0.030
700	$ 0.030	$ 21.00	$ 0.030
800	$ 0.030	$ 24.00	$ 0.030
900	$ 0.030	$ 27.00	$ 0.030
1000	$ 0.030	$ 30.00	$ 0.030

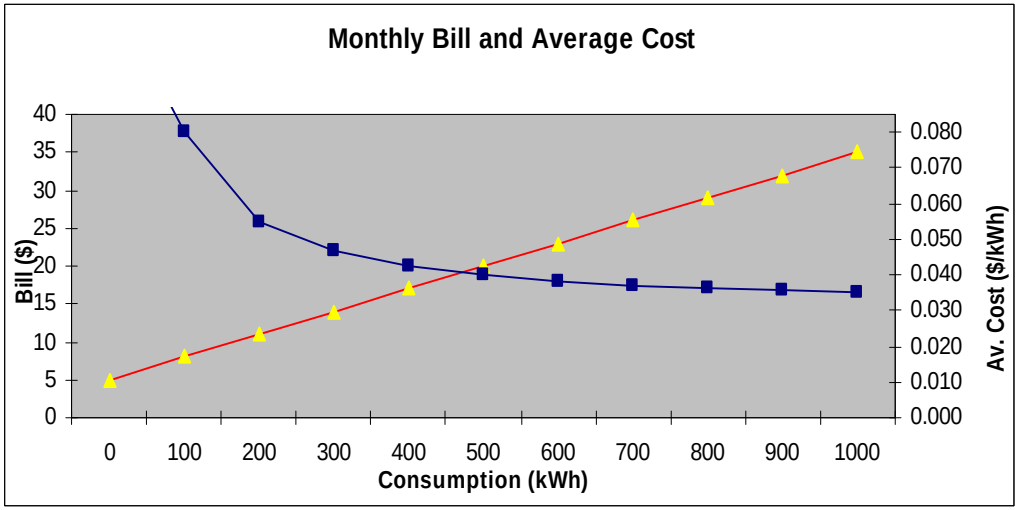


- Pros
  - simple, easy to understand, easy to apply
  - appropriate when price responsiveness of small and large customers is the same and the marginal costs of serving them are equal
- Cons
  - Customers that use little/a lot energy underpay/overpay their fair share of fixed costs
  - Revenues subject to energy consumption fluctuation

Flat Rate with a Customer Charge

Customer Charge $ 5.00

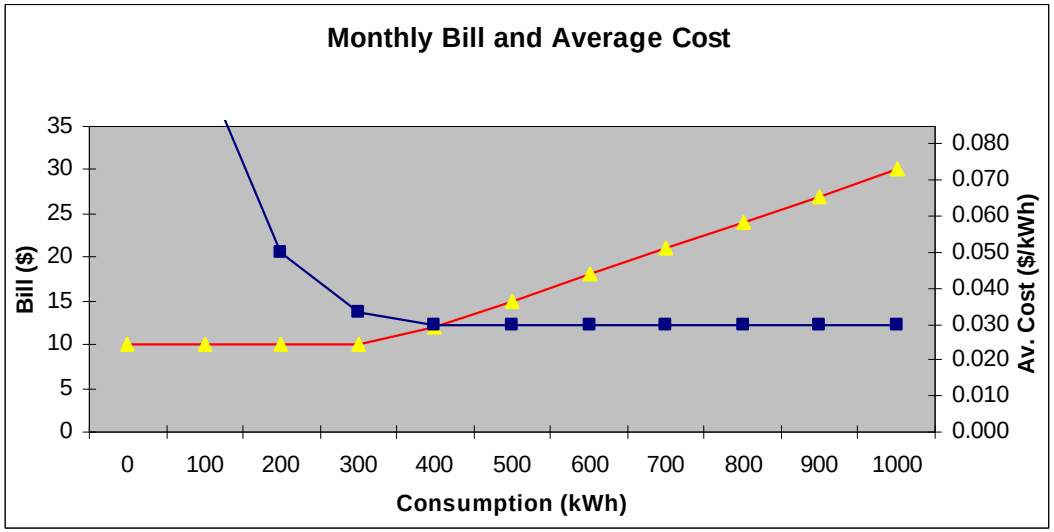
Energy	Rate	Total Bill	Av. Cost
0	$ 0.030	$ 5.00	
100	$ 0.030	$ 8.00	$ 0.080
200	$ 0.030	$ 11.00	$ 0.055
300	$ 0.030	$ 14.00	$ 0.047
400	$ 0.030	$ 17.00	$ 0.043
500	$ 0.030	$ 20.00	$ 0.040
600	$ 0.030	$ 23.00	$ 0.038
700	$ 0.030	$ 26.00	$ 0.037
800	$ 0.030	$ 29.00	$ 0.036
900	$ 0.030	$ 32.00	$ 0.036
1000	$ 0.030	$ 35.00	$ 0.035



- Pros
  - simple, easy to understand, easy to apply
- Cons
  - to a lesser degree similar to Flat Rate

Flat Rate with a Minimum Bill

Energy	Rate	Minimum Charge	Total Bill	Av. Cost
0	$ 0.030	$ 10.00	$ 10.00	
100	$ 0.030	$ 10.00	$ 10.00	$ 0.100
200	$ 0.030	$ 10.00	$ 10.00	$ 0.050
300	$ 0.030	$ 10.00	$ 10.00	$ 0.033
400	$ 0.030	$ 10.00	$ 12.00	$ 0.030
500	$ 0.030	$ 10.00	$ 15.00	$ 0.030
600	$ 0.030	$ 10.00	$ 18.00	$ 0.030
700	$ 0.030	$ 10.00	$ 21.00	$ 0.030
800	$ 0.030	$ 10.00	$ 24.00	$ 0.030
900	$ 0.030	$ 10.00	$ 27.00	$ 0.030
1000	$ 0.030	$ 10.00	$ 30.00	$ 0.030

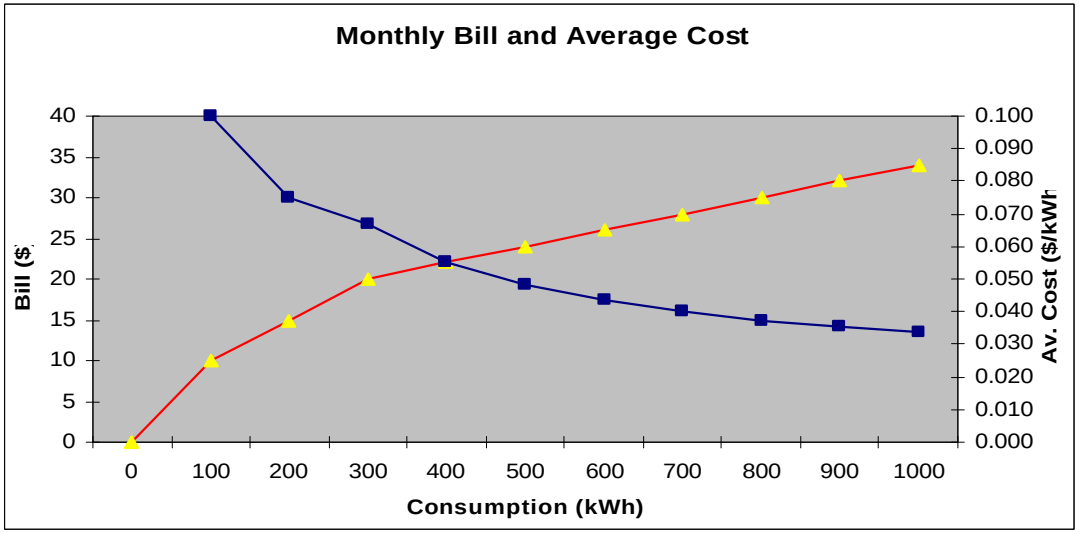


- Pros
  - stabilizes revenue stream to the utility
  - makes revenue less sensitive to changes in consumption
- Cons
  - those that do not use the minimum energy pay more

Declining Block Energy Rate

	First 100 kWh	$	0.10
	Next 200 kWh	$	0.05
All kWh above 300 kWh		$	0.02

Energy	Total Bill	Av. Cost
0	$ -	
100	$ 10.00	$ 0.100
200	$ 15.00	$ 0.075
300	$ 20.00	$ 0.067
400	$ 22.00	$ 0.055
500	$ 24.00	$ 0.048
600	$ 26.00	$ 0.043
700	$ 28.00	$ 0.040
800	$ 30.00	$ 0.038
900	$ 32.00	$ 0.036
1000	$ 34.00	$ 0.034

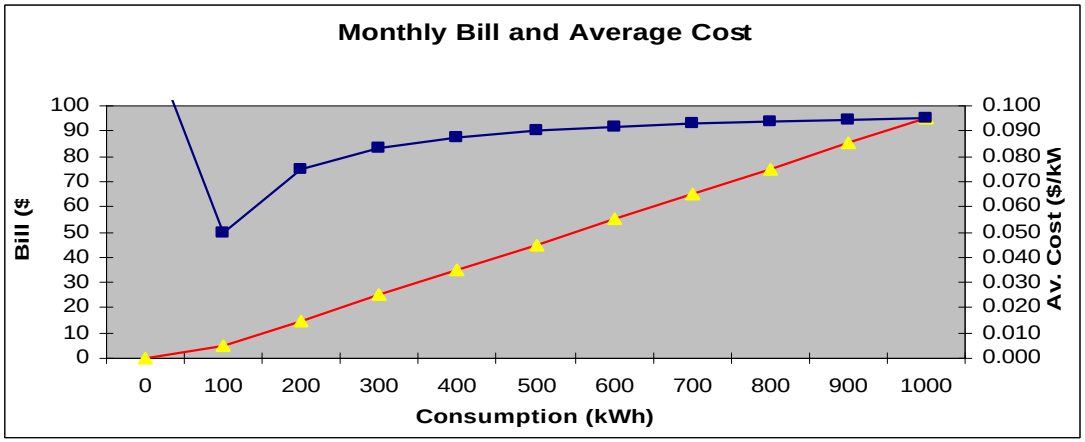


- Pros
  - promotes energy use in the situation of excess capacity
  - appropriate when marginal cost of servicing large users is less than the marginal cost of small users
- Cons
  - adverse effect if marginal cost is rising
  - off-peak users subsidize the on-peak users
  - burdens small users that do not expand consumption

Lifeline Rates

	First 100 kWh	$	0.05
All kWh above 100 kWh		$	0.10

Energy	Total Bill	Av. Cost
0	$ -	
100	$ 5.00	$ 0.050
200	$ 15.00	$ 0.075
300	$ 25.00	$ 0.083
400	$ 35.00	$ 0.088
500	$ 45.00	$ 0.090
600	$ 55.00	$ 0.092
700	$ 65.00	$ 0.093
800	$ 75.00	$ 0.094
900	$ 85.00	$ 0.094
1000	$ 95.00	$ 0.095

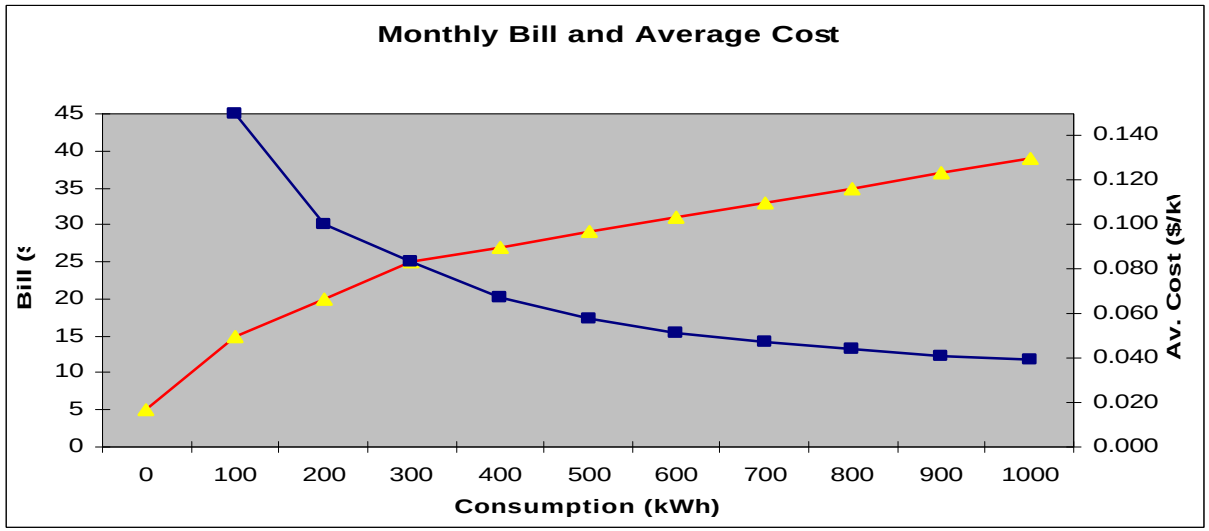


- Pros
  - corrects for the negative effects of declining block rates
  - assures basic service to low income consumers
- Cons
  - abuse by wealthy consumers
  - cross subsidization

Declining Block Rate with Customer Charge

Customer charge	$	5.00
First 100 kWh	$	0.10
Next 200 kWh	$	0.05
All kWh above 300 kWh	$	0.02

Energy	Bill	Av. Cost
0	$ 5.00	
100	$ 15.00	$ 0.150
200	$ 20.00	$ 0.100
300	$ 25.00	$ 0.083
400	$ 27.00	$ 0.068
500	$ 29.00	$ 0.058
600	$ 31.00	$ 0.052
700	$ 33.00	$ 0.047
800	$ 35.00	$ 0.044
900	$ 37.00	$ 0.041
1000	$ 39.00	$ 0.039

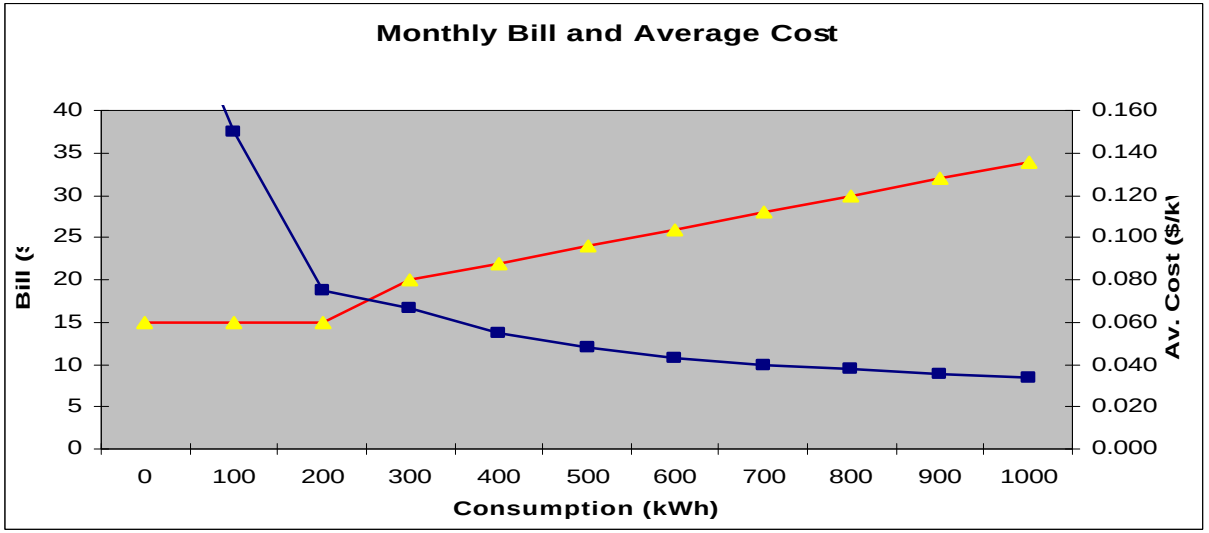


- Pros and Cons similar to those in Declining Block energy rate

Declining Block Rate with a Minimum Bill

Minimum bill	$	15.00
First 100 kWh	$	0.10
Next 200 kWh	$	0.05
All kWh above 300 kWh	$	0.02

Energy	Total Bill	Av. Cost
0	$ 15.00	
100	$ 15.00	$ 0.150
200	$ 15.00	$ 0.075
300	$ 20.00	$ 0.067
400	$ 22.00	$ 0.055
500	$ 24.00	$ 0.048
600	$ 26.00	$ 0.043
700	$ 28.00	$ 0.040
800	$ 30.00	$ 0.038
900	$ 32.00	$ 0.036
1000	$ 34.00	$ 0.034

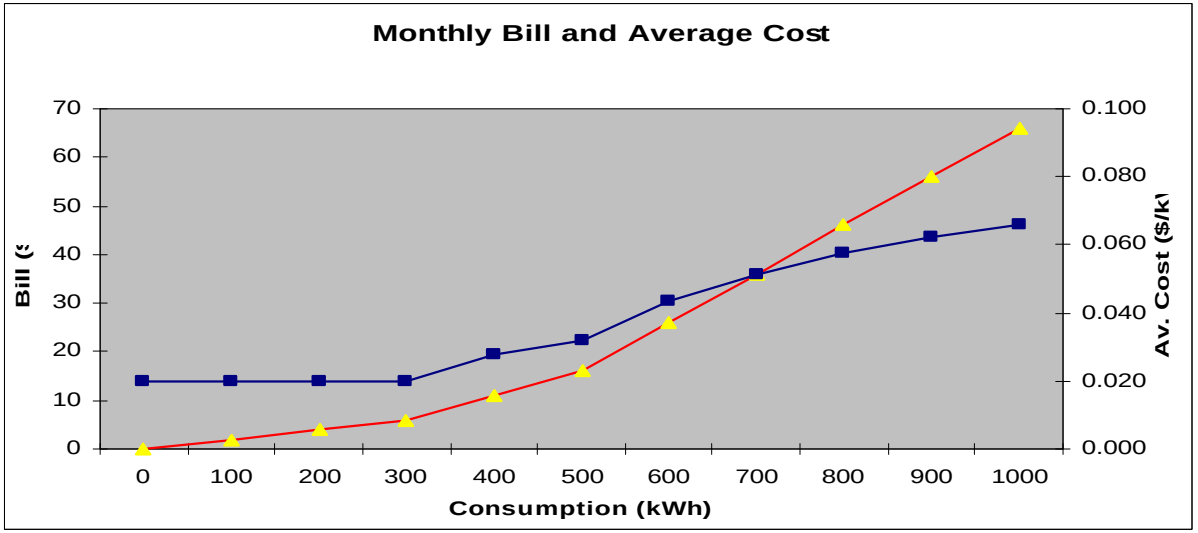


- Pros and Cons similar to those in Declining Block energy rate

Inverted Energy Rate

	Minimum bill	$	-
	First 300 kWh	$	0.02
	Next 200 kWh	$	0.05
	All kWh above 500 kWh	$	0.10

Energy	Total Bill	Av. Cost
0	$ -	
100	$ 2.00	$ 0.020
200	$ 4.00	$ 0.020
300	$ 6.00	$ 0.020
400	$ 11.00	$ 0.028
500	$ 16.00	$ 0.032
600	$ 26.00	$ 0.043
700	$ 36.00	$ 0.051
800	$ 46.00	$ 0.058
900	$ 56.00	$ 0.062
1000	$ 66.00	$ 0.066

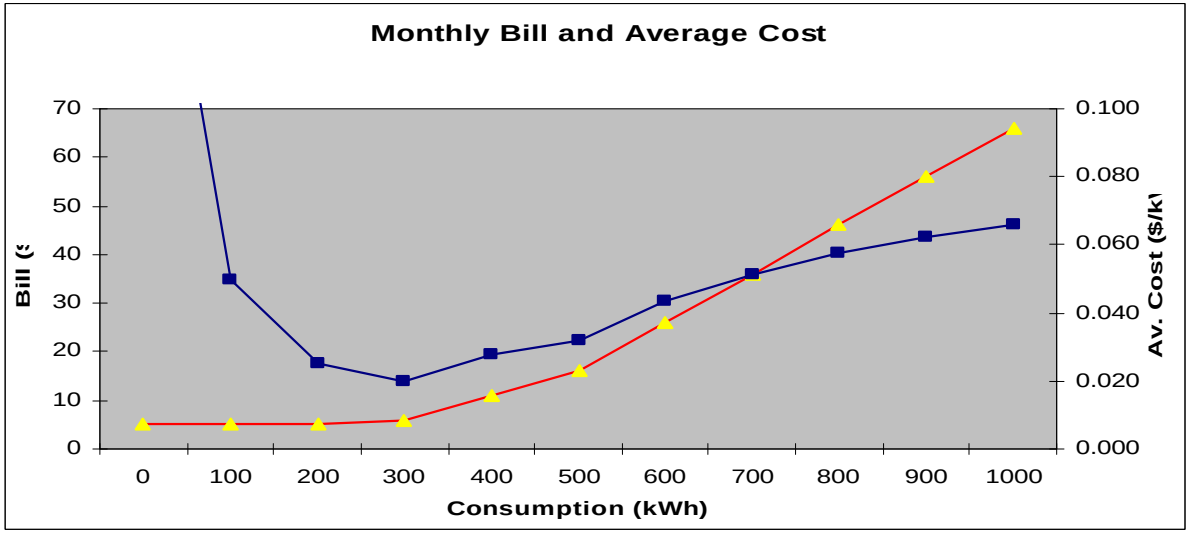


- Pros
  - promotes conservation of energy
  - appropriate if the marginal cost of serving large users is greater than the marginal cost of small users
- Cons
  - potential subsidization of small users by large users

Inverted Energy Rate with a Minimum Bill

	Minimum Bill	$	5.00
	First 300 kWh	$	0.02
	Next 200 kWh	$	0.05
	All kWh above 500 kWh	$	0.10

Energy	Total Bill	Av. Cost
0	$ 5.00	
100	$ 5.00	$ 0.050
200	$ 5.00	$ 0.025
300	$ 6.00	$ 0.020
400	$ 11.00	$ 0.028
500	$ 16.00	$ 0.032
600	$ 26.00	$ 0.043
700	$ 36.00	$ 0.051
800	$ 46.00	$ 0.058
900	$ 56.00	$ 0.062
1000	$ 66.00	$ 0.066

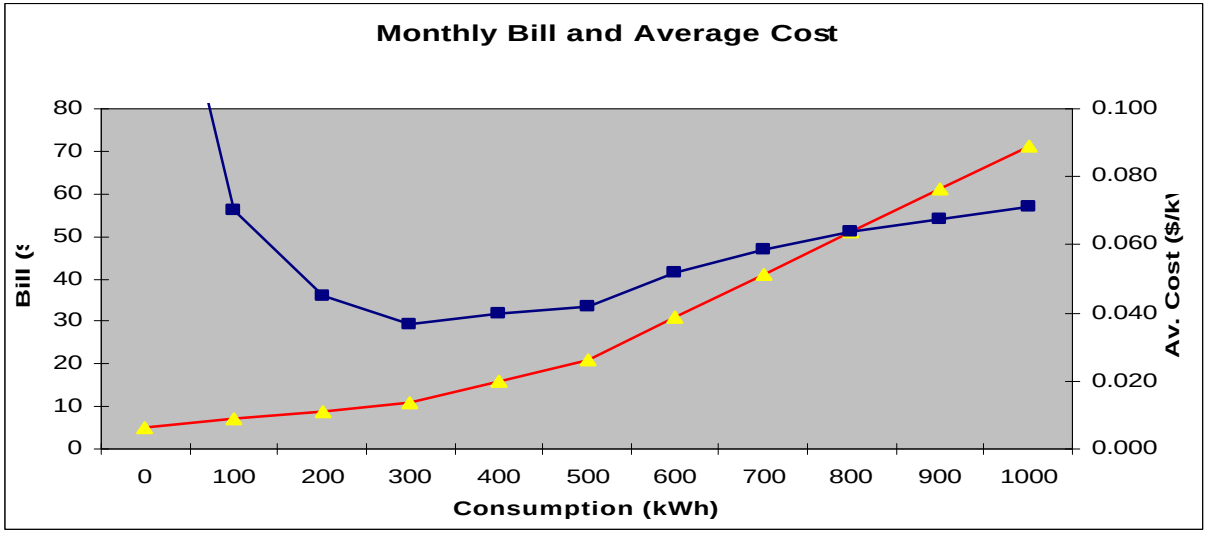


- Pros and Cons similar to those for Inverted Energy Rate

Inverted Energy Rate with a Customer Charge

Customer Charge	$	5.00
First 300 kWh	$	0.02
Next 200 kWh	$	0.05
All kWh above 500 kWh	$	0.10

Energy	Total Bill	Av. Cost
0	$ 5.00	
100	$ 7.00	$ 0.070
200	$ 9.00	$ 0.045
300	$ 11.00	$ 0.037
400	$ 16.00	$ 0.040
500	$ 21.00	$ 0.042
600	$ 31.00	$ 0.052
700	$ 41.00	$ 0.059
800	$ 51.00	$ 0.064
900	$ 61.00	$ 0.068
1000	$ 71.00	$ 0.071

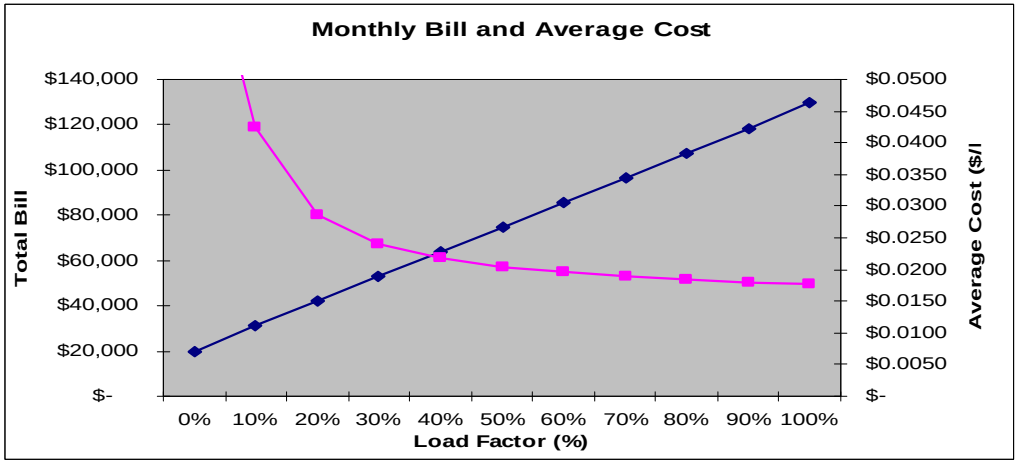


- Pros and Cons similar to those for Inverted Energy Rate

Energy and Demand Rate

Demand ($/kW)	$ 2.00
Energy ($/kWh)	$ 0.015
Load (kW)	10,000

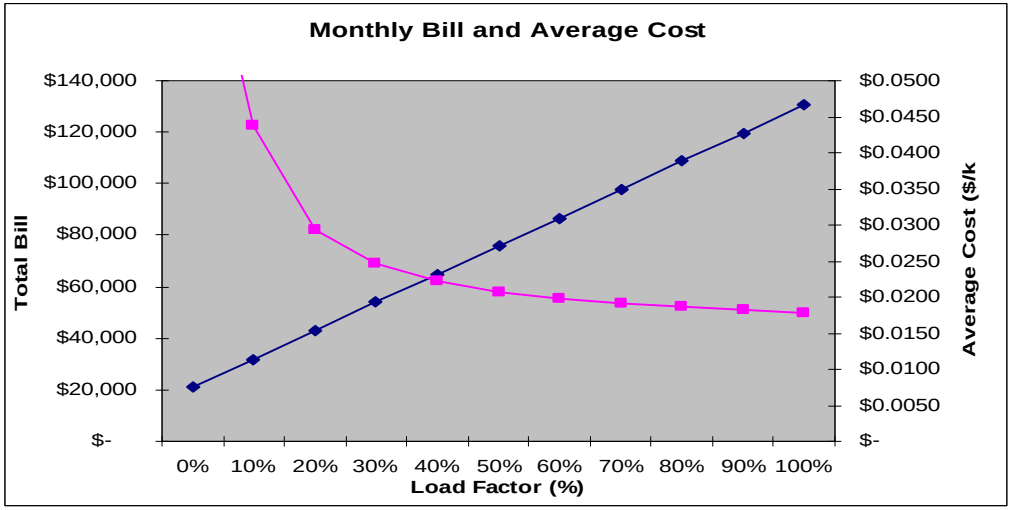
LF	Energy	Demand Charge	Energy Charge	Total Bill	Average Cost
0%	-	$ 20,000	$ -	$ 20,000	
10%	730,000	$ 20,000	$ 10,950	$ 30,950	$ 0.0424
20%	1,460,000	$ 20,000	$ 21,900	$ 41,900	$ 0.0287
30%	2,190,000	$ 20,000	$ 32,850	$ 52,850	$ 0.0241
40%	2,920,000	$ 20,000	$ 43,800	$ 63,800	$ 0.0218
50%	3,650,000	$ 20,000	$ 54,750	$ 74,750	$ 0.0205
60%	4,380,000	$ 20,000	$ 65,700	$ 85,700	$ 0.0196
70%	5,110,000	$ 20,000	$ 76,650	$ 96,650	$ 0.0189
80%	5,840,000	$ 20,000	$ 87,600	$ 107,600	$ 0.0184
90%	6,570,000	$ 20,000	$ 98,550	$ 118,550	$ 0.0180
100%	7,300,000	$ 20,000	$ 109,500	$ 129,500	$ 0.0177



Energy, Demand and Customer Charge Rate

Customer Charge ($)		$1,000
Demand ($/kW)		$ 2.00
Energy ($/kWh)		$ 0.015
	Load (kW)	10,000

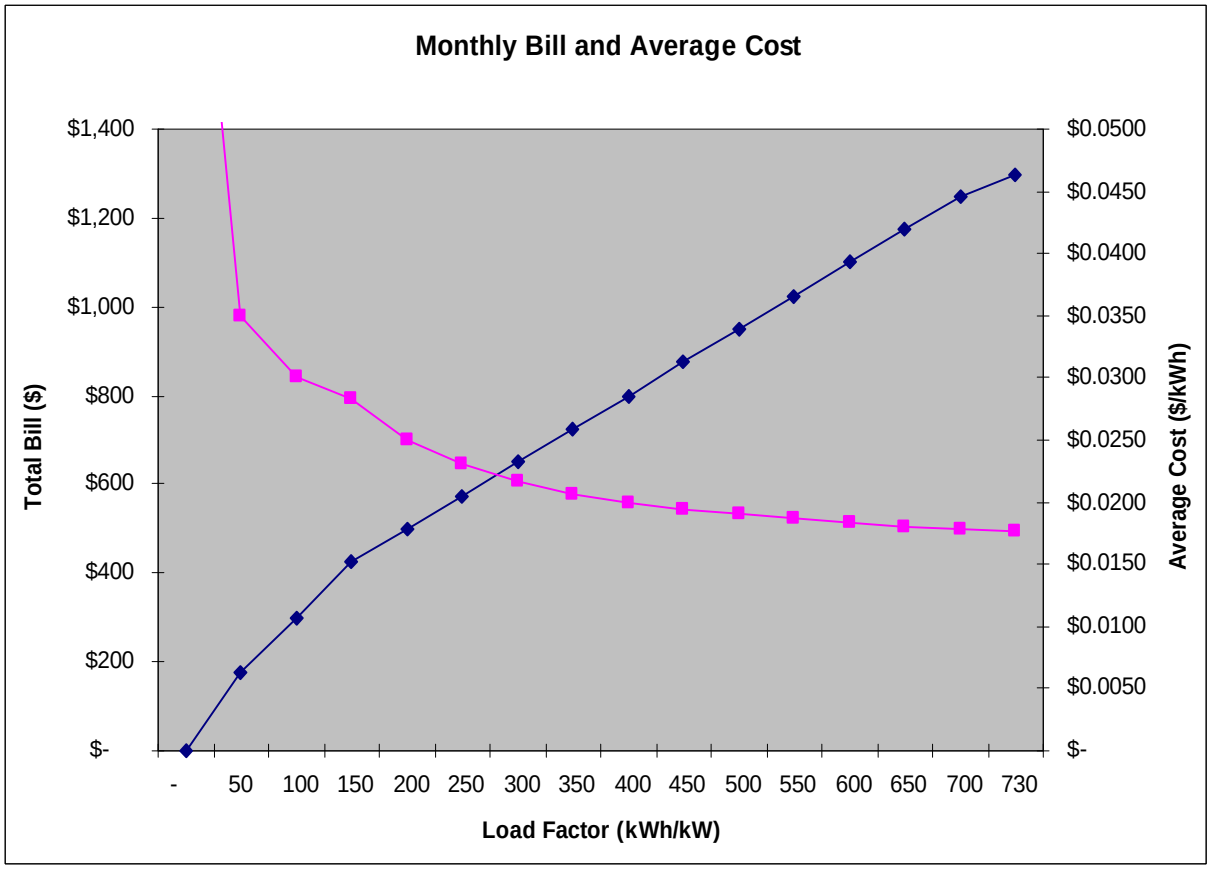
LF	Energy	Demand Charge	Energy Charge	Total Bill	Average Cost
0%	-	$ 20,000	$ -	$ 21,000	
10%	730,000	$ 20,000	$ 10,950	$ 31,950	$ 0.0438
20%	1,460,000	$ 20,000	$ 21,900	$ 42,900	$ 0.0294
30%	2,190,000	$ 20,000	$ 32,850	$ 53,850	$ 0.0246
40%	2,920,000	$ 20,000	$ 43,800	$ 64,800	$ 0.0222
50%	3,650,000	$ 20,000	$ 54,750	$ 75,750	$ 0.0208
60%	4,380,000	$ 20,000	$ 65,700	$ 86,700	$ 0.0198
70%	5,110,000	$ 20,000	$ 76,650	$ 97,650	$ 0.0191
80%	5,840,000	$ 20,000	$ 87,600	$ 108,600	$ 0.0186
90%	6,570,000	$ 20,000	$ 98,550	$ 119,550	$ 0.0182
100%	7,300,000	$ 20,000	$109,500	$ 130,500	$ 0.0179



Hours-of-use Demand Rate

First 50 kWh per kW of demand			$ 0.035
Next 100 kWh per kW of demand			$ 0.025
All energy in excess of 150 kWh per kW			$ 0.015
		Load (kW)	100

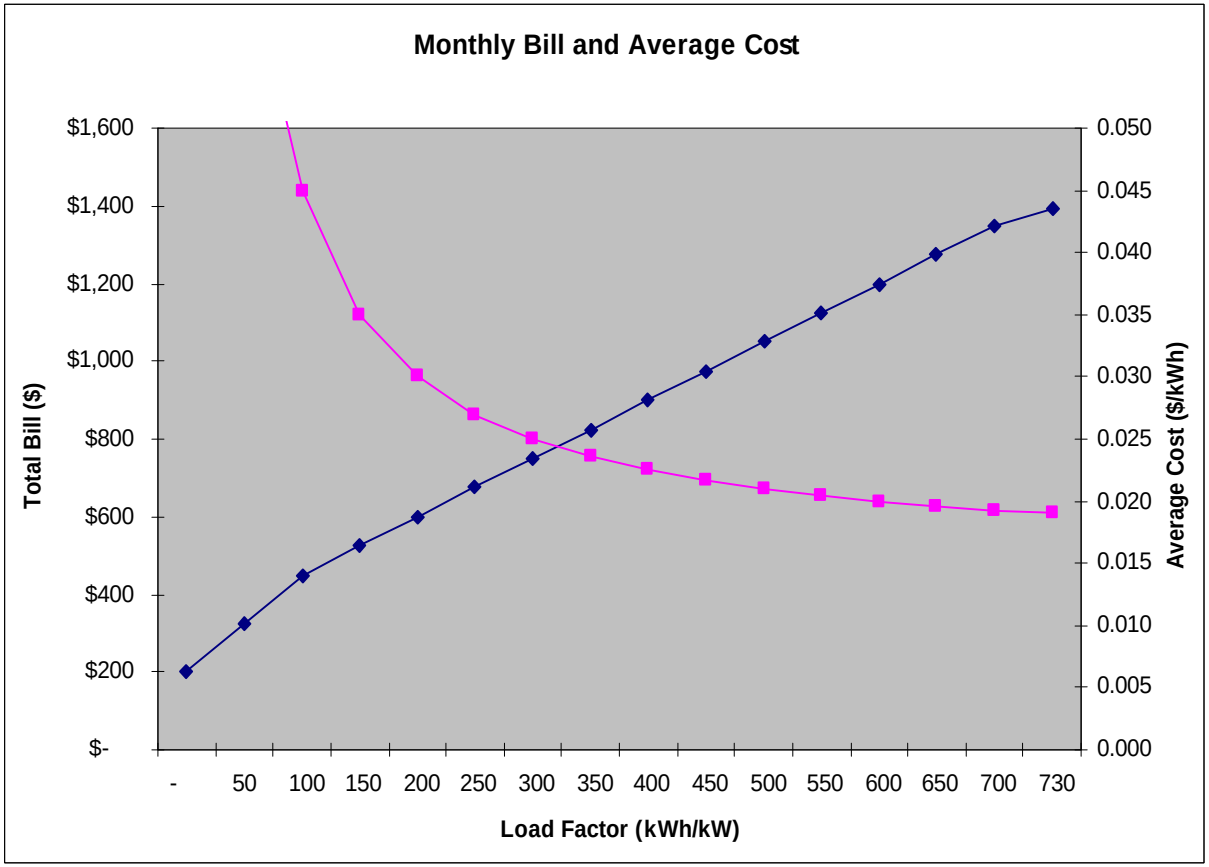
LF (kWh/kW)	Energy (kWh)	Total Bill	Average Cost
-	-	$ -	
50	5,000	$ 175	$ 0.0350
100	10,000	$ 300	$ 0.0300
150	15,000	$ 425	$ 0.0283
200	20,000	$ 500	$ 0.0250
250	25,000	$ 575	$ 0.0230
300	30,000	$ 650	$ 0.0217
350	35,000	$ 725	$ 0.0207
400	40,000	$ 800	$ 0.0200
450	45,000	$ 875	$ 0.0194
500	50,000	$ 950	$ 0.0190
550	55,000	$ 1,025	$ 0.0186
600	60,000	$ 1,100	$ 0.0183
650	65,000	$ 1,175	$ 0.0181
700	70,000	$ 1,250	$ 0.0179
730	73,000	$ 1,295	$ 0.0177



Hours-of-use Rate with Customer Charge

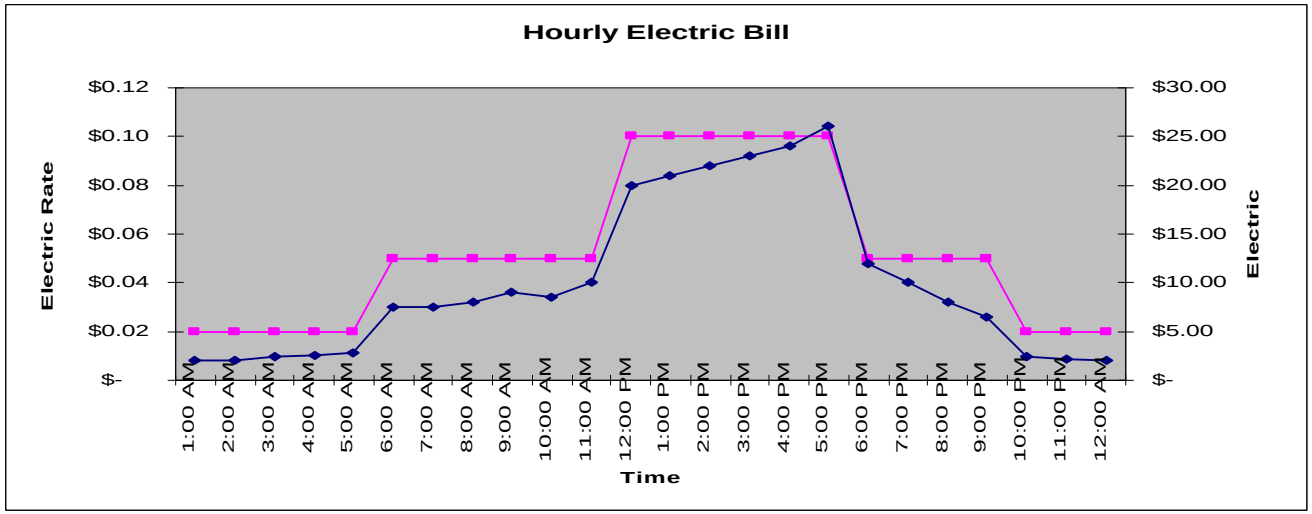
	Demand Charge ($/kW)	$ 2.00
First 100 kWh per kW of demand		$ 0.025
All energy in excess of 100 kWh per kW		$ 0.015
	Load (kW)	100

LF (kWh/kW)	Energy (kWh)	Total Bill	Average Cost
-	-	$ 200	
50	5,000	$ 325	$ 0.0650
100	10,000	$ 450	$ 0.0450
150	15,000	$ 525	$ 0.0350
200	20,000	$ 600	$ 0.0300
250	25,000	$ 675	$ 0.0270
300	30,000	$ 750	$ 0.0250
350	35,000	$ 825	$ 0.0236
400	40,000	$ 900	$ 0.0225
450	45,000	$ 975	$ 0.0217
500	50,000	$ 1,050	$ 0.0210
550	55,000	$ 1,125	$ 0.0205
600	60,000	$ 1,200	$ 0.0200
650	65,000	$ 1,275	$ 0.0196
700	70,000	$ 1,350	$ 0.0193
730	73,000	$ 1,395	$ 0.0191



Time-of-day Energy Rate

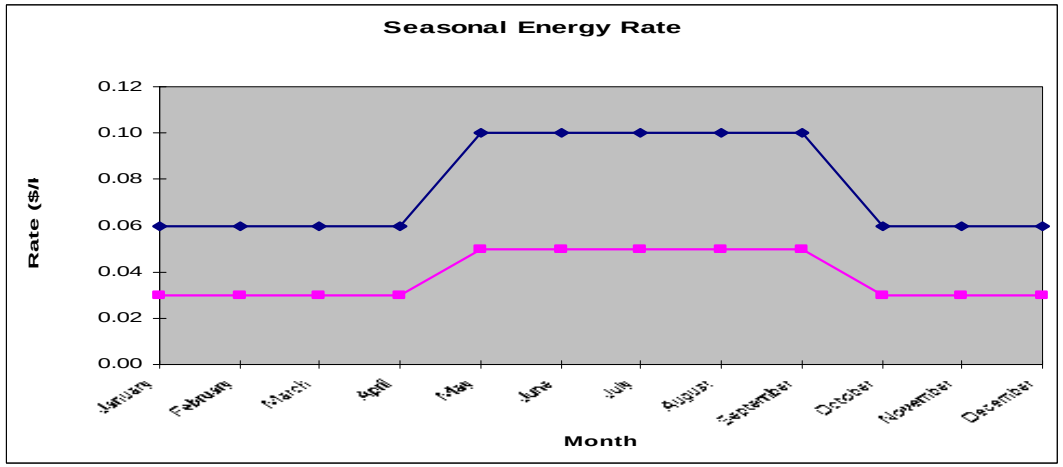
Time	Rate	Period	Usage	Bill
1:00 AM	$0.02	Off-peak	100	$ 2.00
2:00 AM	$0.02	Off-peak	100	$ 2.00
3:00 AM	$0.02	Off-peak	120	$ 2.40
4:00 AM	$0.02	Off-peak	130	$ 2.60
5:00 AM	$0.02	Off-peak	140	$ 2.80
6:00 AM	$0.05	Shoulder	150	$ 7.50
7:00 AM	$0.05	Shoulder	150	$ 7.50
8:00 AM	$0.05	Shoulder	160	$ 8.00
9:00 AM	$0.05	Shoulder	180	$ 9.00
10:00 AM	$0.05	Shoulder	170	$ 8.50
11:00 AM	$0.05	Shoulder	200	$10.00
12:00 PM	$0.10	On-peak	200	$20.00
1:00 PM	$0.10	On-peak	210	$21.00
2:00 PM	$0.10	On-peak	220	$22.00
3:00 PM	$0.10	On-peak	230	$23.00
4:00 PM	$0.10	On-peak	240	$24.00
5:00 PM	$0.10	On-peak	260	$26.00
6:00 PM	$0.05	Shoulder	240	$12.00
7:00 PM	$0.05	Shoulder	200	$10.00
8:00 PM	$0.05	Shoulder	160	$ 8.00
9:00 PM	$0.05	Shoulder	130	$ 6.50
10:00 PM	$0.02	Off-peak	120	$ 2.40
11:00 PM	$0.02	Off-peak	110	$ 2.20
12:00 AM	$0.02	Off-peak	100	$ 2.00



- Pros
  - sends proper price signals to consumers
  - promotes load factor improvement while constraining new investment
  - customers can control their energy cost
- Cons
  - costly to meter
  - counter effective if excess capacity exists

Seasonal Energy Rate

Month	Customer Charge	Rate 0-500 kWh	Above 500 Kwh	Designation
January	$ 2.50	$ 0.03	$ 0.06	Off-peak
February	$ 2.50	$ 0.03	$ 0.06	Off-peak
March	$ 2.50	$ 0.03	$ 0.06	Off-peak
April	$ 2.50	$ 0.03	$ 0.06	Off-peak
May	$ 2.50	$ 0.05	$ 0.10	Peak
June	$ 2.50	$ 0.05	$ 0.10	Peak
July	$ 2.50	$ 0.05	$ 0.10	Peak
August	$ 2.50	$ 0.05	$ 0.10	Peak
September	$ 2.50	$ 0.05	$ 0.10	Peak
October	$ 2.50	$ 0.03	$ 0.06	Off-peak
November	$ 2.50	$ 0.03	$ 0.06	Off-peak
December	$ 2.50	$ 0.03	$ 0.06	Off-peak



- Pros and Cons similar to those of Time-of-day rates

Ratchet Demand Clause

- Billing method that charges the consumer the higher of fixed percentage of his maximum monthly demand in a specified period of time or his current demand
  - provides revenue stability to the utility
  - distributes revenue responsibility more equitably between high- and low-load factor customers
  - provides a price signal for increasing annual load factor
  - may induce unnecessary consumption during other than on-peak times
  - may impose financial hardship on low-load factor customers
- Can be set either equal to or higher than the class load factor

Interruptible Rates

- Utility, or customer at utility's request, interrupts the use of a certain amount of electric load
- Provide utilities a means of reducing their generating, transmission and distribution capacity requirements and stabilizing system frequency
- Offer customers an alternative to self-generation and leaving or by-passing a utility system
- Appropriate to customers that are willing to accept decreased reliability in exchange for a reduced demand charge

Real-time Pricing (RTP)

- Real-time prices vary to reflect changes in the marginal cost of supplying electricity
- Rates vary hourly, as oppose to a pre-defined manner in TOU rates
- Pros
  - provide proper price signal
  - customer decides when to purchase electricity
  - RTP tend to decrease the peak use
- Cons
  - expensive implementation cost

Standby Rates

- Power is taken from the utility by a customer who self generates. The customer is entitled to power on demand. Power offered by the utility comes as supplementary, maintenance or backup power.
- Supplementary power-supplied anytime in addition to what the customer ordinarily generates. It is usually priced at the same price as regular firm service.
- Maintenance power- power supplied during scheduled outages of the customer's own generating facility. Since the service is scheduled power can be delivered during off-peak times and be priced at level lower than firm service.
- Backup power-power supplied during unscheduled outages. It is priced between supplementary and maintenance service

Economic Development Rates (EDR)

- Help to expand loads by encouraging new businesses to move into a service territory or by helping existing businesses stay and grow.
- Provide discounts for incremental energy and demand
- Pros
  - increase the customer base, energy usage/revenue, employment
  - retains existing businesses, prevents negative effects on the local economy
- Cons
  - accelerate the utility's need for capacity expansion
  - may provide unfair advantage to businesses

Demand-side Management (DSM)

- Combination of conservation and load-management policies and techniques that influence customers pattern of energy use without decreasing their current comfort level
- Benefits to the customers
  - lower monthly electricity bills
  - increase in comfort level
- Benefits to the utility
  - reduced fuel costs
  - deferred capital additions
  - control of peak demands
  - improved generating efficiency
  - increased system reliability

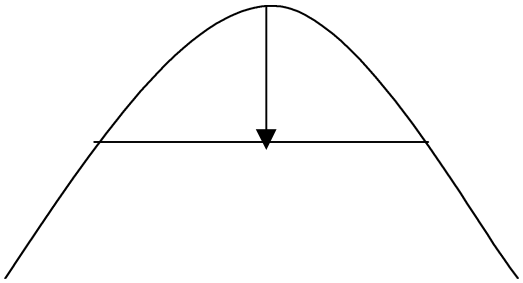
Types of DSM Programs

- **Passive-**programs require utility-initiated efforts; however once the programs are implemented the utility no longer influences the effects
- **Active-**programs require utility control, usually through a signal to a device or a customer

DSM Programs

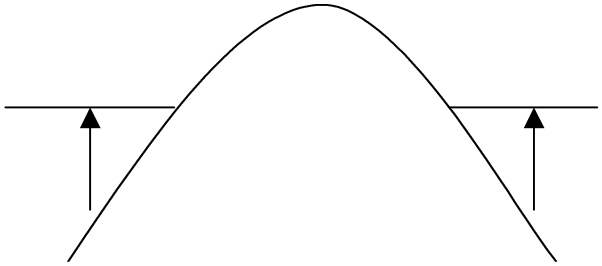
- Design
  - objective
  - participants
  - DSM potential
  - costs
- Implementation
  - timing
  - third-party involvement
- Evaluation
  - engineering analysis
  - cost-benefit analysis

DSM Objectives



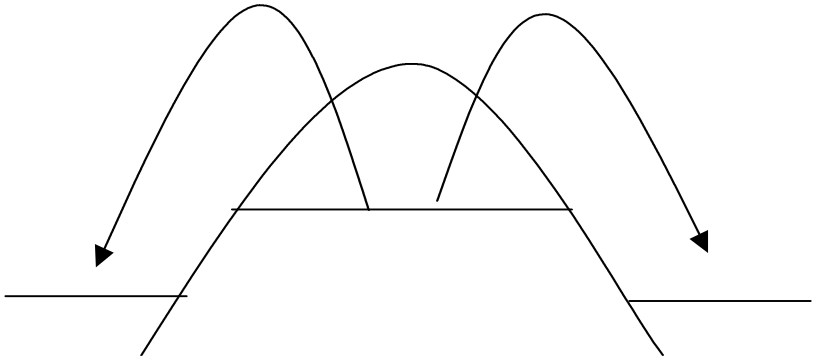
Peak clipping

- direct load control



Valley filling

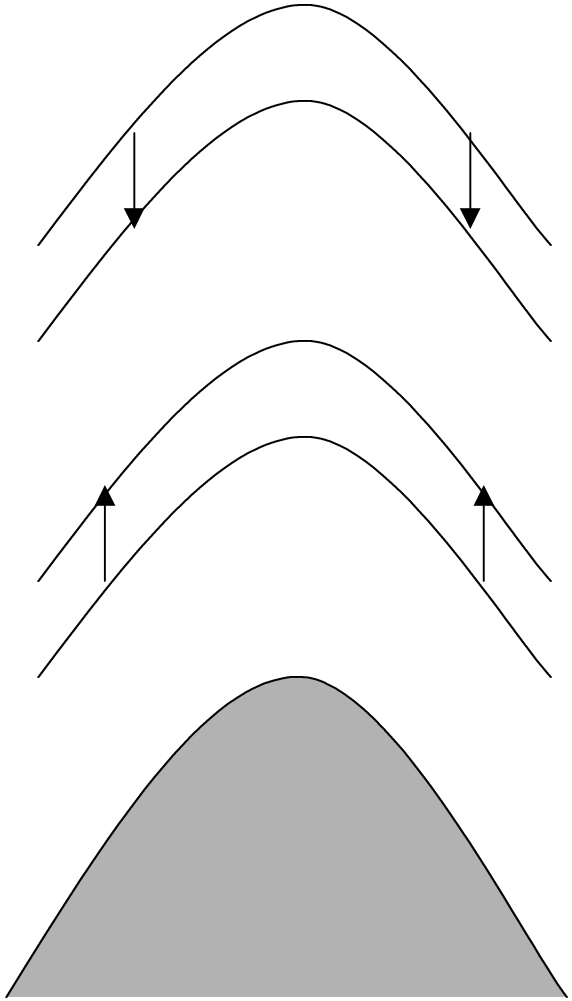
- nighttime security lighting



Load shifting

- thermal storage

DSM Objectives (cont.)



Strategic conservation

- insulation, efficient end-use

Strategic load growth

- economic development

Flexible load shape

- interruptible load

Cost-Benefit Analysis of DSM Programs

- the Participant Test
  - compares the benefits and costs to the customer due to the participation in a program
- the Utility Cost Test (Revenue Requirement Test)
  - measures net costs of a program as a resource option based on the costs incurred by the utility
- The Rate Impact Measure (Non-participants Test)
  - measures an impact on customer bill or rates due to changes in utility revenues and operating costs caused by the program
- the Total Resource Cost Test
  - measures net costs of a DSM program as a resource option based on the total cost of the program

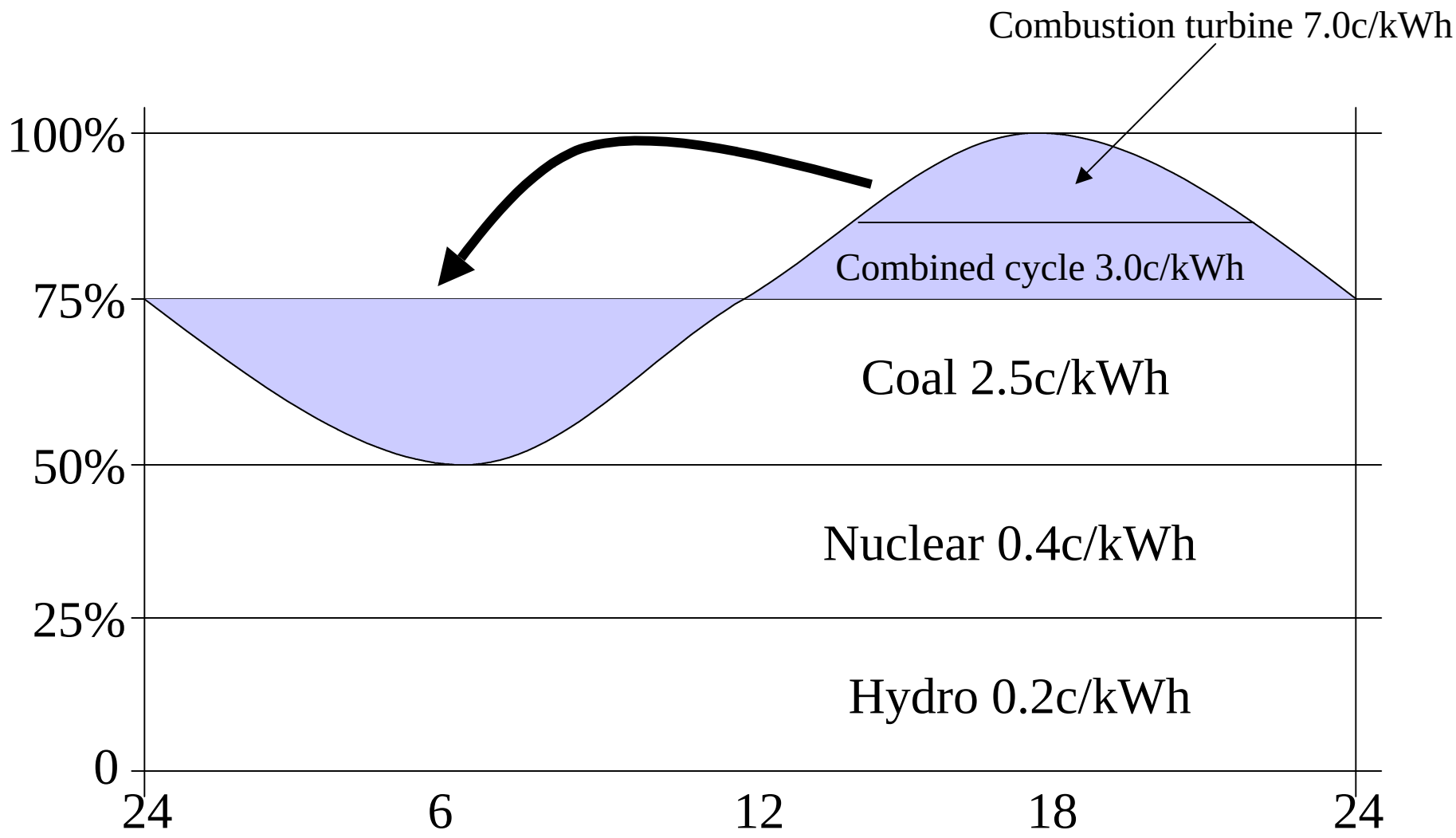
Cost-Benefit Analysis of DSM Programs (cont.)

- Societal Test
  - measures the change in the total resource costs to society as a whole rather than to only the service territory

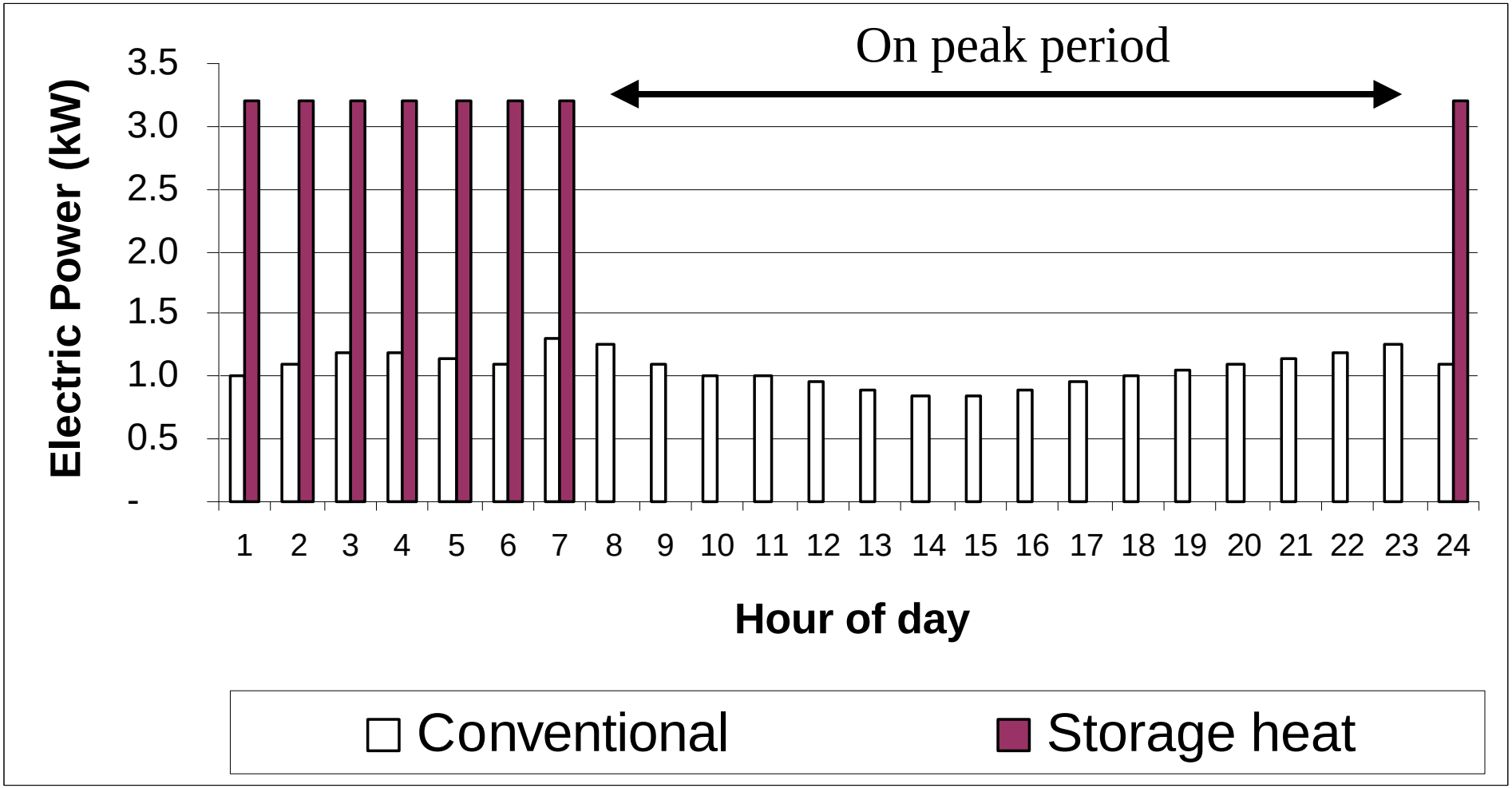
Which test is the best?

All five perspectives provide valuable information in the evaluation of a program. If a program fails from one perspective it can be redesigned.

Load Shift Concept



Storage vs. Conventional Electric Heat



Conventional and Storage Heating

	Conventional Heating				Conventional Heating on TOU Rates				Storage Heating on TOU Rates				Storage Water and Heating on TOU Rates			
Usage	**Period**	**kWh**	**Rate**	**Cost**	**Period**	**kWh**	**Rate**	**Cost**	**Period**	**kWh**	**Rate**	**Cost**	**Period**	**kWh**	**Rate**	**Cost**
Base	On peak	1,600	$0.06	$ 96.00	On peak	1,600	$ 0.11	$ 169.60	On peak	1,600	$ 0.11	$ 169.60	On peak	1,200	$ 0.11	$ 127.20
	Off peak	2,400	$0.06	$ 144.00	Off peak	2,400	$ 0.03	$ 69.60	Off peak	2,400	$ 0.03	$ 69.60	Off peak	2,800	$ 0.03	$ 81.20
	Total	4,000		$ 240.00	Total	4,000		$ 239.20	Total	4,000		$ 239.20	Total	4,000		$ 208.40
Water Heat	On peak	2,000	$0.06	$ 120.00	On peak	2,000	$ 0.11	$ 212.00	On peak	2,000	$ 0.11	$ 212.00	On peak	-	$ 0.11	$ -
	Off peak	2,000	$0.06	$ 120.00	Off peak	2,000	$ 0.03	$ 58.00	Off peak	2,000	$ 0.03	$ 58.00	Off peak	4,000	$ 0.03	$ 116.00
	Total	4,000		$ 240.00	Total	4,000		$ 270.00	Total	4,000		$ 270.00	Total	4,000		$ 116.00
Space Heat	On peak	4,200	$0.06	$ 252.00	On peak	4,200	$ 0.11	$ 445.20	On peak	-	$ 0.11	$ -	On peak	-	$ 0.11	$ -
	Off peak	7,800	$0.06	$ 468.00	Off peak	7,800	$ 0.03	$ 226.20	Off peak	12,000	$ 0.03	$ 348.00	Off peak	12,000	$ 0.03	$ 348.00
	Total	12,000		$ 720.00	Total	12,000		$ 671.40	Total	12,000		$ 348.00	Total	12,000		$ 348.00
Annual Bill				**$ 1,200.00**				**$ 1,180.60**				**$ 857.20**				**$ 672.40**
Savings				**$ -**				**$ 19.40**				**$ 342.80**				**$ 527.60**

Tariff Setting

- Tariffs can be reviewed and modified at the Commission's or Licensee's initiative (Energy Law, Article 34)
- Review is based on the information provided by the Licensee (Energy Law, Article 35)
- Penalties can be imposed on those that do not follow Commission's directives (Energy Law, Article 27)
- The review process at the Energy Commission is governed by the internal Commission's Rules and Procedures
- The tariffs are set using principles described in the law (Energy Law, Article 14)
- No tariff decision can be appealed (Energy Law, Article 28)

Consumer Rights and Obligations

- Energy usage has to be metered
  - Energy Law, Article 7
- Illegal consumption is prohibited
  - Energy Law, Article 8
- Delivered energy has to be of a certain quality
  - Civil Code, Article 554
- Payment for energy has to be made in a timely manner
  - Civil Code, Article 556
- Services can be disconnected for non-payment
  - Civil Code, Article 558

Disputes

- Any dispute between the supplier and the user of the energy should be resolved between them first
- If no satisfactory solution can be found the next step is to file a complaint with the Energy Commission
- The Energy Commission will attempt to decide the case (Energy Law, Article 20)
- If the Commission's decision does not satisfy any of the parties involved it can be further appealed to the court with the exception of tariff setting (Energy Law, Article 28)